AYK Region
Stock Status Rpt 25

Alaska Research Associates

LGL

Alaska Research Associates, Inc.

Suite 201, 505 West Northern Lights Blvd.
Anchorage, Alaska 99503
(907) 276-3339

LGL Alaska
2950 Fritz Cove Road
Juneau, Alaska
99801

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000
Juneau, Alaska
99802

Attention: Phil Rigby

Dear Mr. Rigby,

Enclosed are 4 copies of our proposal for the 1987 South Peninsula Tagging Study. It consists of two parts, a Project Operational Plan and a Technical Proposal. Should you have any questions, please call me in Juneau (789-7311) or our administrative manager John Cole (409-775-2000).

Sincerely,

Peter Craig

Peter Craig

PC:ljc
encl.

cc: John Cole

TECHNICAL PROPOSAL

SOUTH PENINSULA TAGGING STUDY 1987

Submitted by

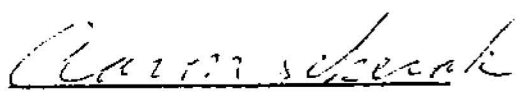
LGL Alaska Research Associates, Inc.
505 West Northern Lights Blvd.
Anchorage, Alaska 99503

To

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000
Juneau, Alaska 99802
Attn: Phil Rigby

30 December 1986

Approved by:



Vice-President, LGL Limited
Aaron Sekerak

TABLE OF CONTENTS

INTRODUCTION

As part of its mandate to manage Alaska's salmon fisheries, the Alaska Department of Fish and Game (ADFG) desires to identify the stock composition of chum and sockeye salmon harvested in the South Peninsula June Fishery (South Unimak and Shumagin Island areas). A considerable controversy has arisen in recent years about the origin and harvest levels of stocks taken in these fisheries.

Previous tagging studies have shown that a substantial portion of the sockeye and chum taken in these fisheries were not of local origin (Thorsteinson and Merrell 1964; Brannian 1984). Tag recoveries indicated that these fisheries were intercepting chum salmon primarily from western Alaska, but also from Japan, Russia, British Columbia and Washington. The sockeye salmon were primarily from Bristol Bay with minor interceptions of sockeye bound for Alaska Peninsula streams.

The available data are of limited use for present day management needs, however, for several reasons. The data are at least 20 years old and during this period there have been large-scale changes in stock composition of salmon in the north Pacific and significant changes in harvest locations and quantities. Recognizing the need for current estimates of stock composition and interception rates, ADFG has issued a Request for Proposal to tag sockeye and chum in these fisheries in 1987.

LGL Alaska Research Associates, Inc. (LGL) submits the following technical proposal in response to this solicitation. This proposal consists of two sections: (1) Project Operational Plan: and (2) Technical Proposal. The latter provides supportive documentation for the former.

The objectives of the work to be conducted are as follows:

1. Apply at least 15,000 readily visible external tags to chum salmon within the study area and return healthy tagged fish fish to the water.

2. Apply at least 10,000 readily visible external tags to sockeye salmon in the study area and return healthy tagged fish to the water.

3. Publicize the tagging effort to harvesters and agencies in Asia and North America.

4. Tabulate and document data on the tagging of each fish and the recovery of each tag.

5. Communicate the results of the tagging study in a coherent and timely manner.

SAMPLING DESIGN

Shaul (1985) has summarized the South Peninsula June Fishery as follows. The Shumagin fishery is located primarily around the Popof, Unga and Korovin Islands in the northern Shumagins. Popof Head is usually the center of activity. The South Unimak fishery occurs at two locations along the south side of Unimak Island: (1) Ikatan Bay to Cape Lazaref on the southeast end; and (2) in the vicinity of Cape Lutke on the southwest end.

Beginning in 1985, the Board of Fish and Game established guideline harvest levels based on percentages of the latest projected runs of Bristol Bay sockeye salmon. The South Unimak fishery is allocated 6.8% of the projected run while the Shumagin fishery is allocated 1.5%. These guideline harvest levels are distributed proportionally over the June runs to avoid excessive impacts on any segment of the runs. These fisheries were open 8 days in 1985 and 4-5 days in 1986 (A. Shaul, pers. comm.). In 1987, the projected strength of the Bristol Bay sockeye run is low (ADFG 1986), therefore it is likely that catch quotas for the South Peninsula June fishery will be quickly met and commercial openings may again be approximately one day per week.

Tag Application

The criteria for tag application are two-fold: (1) the relative tagging effort should reflect the historical fishing effort in the two fishing areas; and (2) tags are to be applied so that the fraction of the population tagged is the same with respect to time and species.

The first point is a straightforward calculation. The South Unimak and Shumagin fisheries are allocated 6.8% and 1.5%, respectively, of the projected run of Bristol Bay sockeye, for a total of 8.3%. Thus, the South Unimak fishery accounts for 82% of the total salmon catch in the two areas, with the remainder (18%) from the Shumagin fishery. This ratio would therefore apply to the allocation of the 15,000 chum tags and 10,000 sockeye tags in the present study.

	TAGS	
Area	Chum	Sockeye
South Unimak (82%)	12,300	8,200
Shumagin (18%)	2,700	1,800
Total	15,000	10,000

The second point is more complex although a reasonable approximation is possible. Actual estimates of stock abundances through time are not available but the commercial fishery itself provides a useful measure of this. The commercial data can be used to address two assumptions regarding tag application:

1. Are chum or sockeye proportionally more abundant in one or the other fishing areas?

   Commercial landings in the two areas in recent years (1980-1985) indicate that the relative abundance of two species are similar.

	Commercial Harvest*(%)	
Area	Chum	Sockeye
South Unimak	78	22
Shumagin	76	24

* from Shaul et al. 1984.

2. Does the weekly allotment of allowable harvest parallel real changes in fish abundance in the two areas?

Typical daily catches of sockeye and chum in the South Unimak and Shumagin fisheries are shown in Figures 1 and 2. The particular years illustrated were selected because they have the longest records of consecutive days fished and thus might be expected to reflect the run strength (i.e., daily abundance) of chum and sockeye in the two areas. Note, however, that fishing effort (on either consecutive days or between years) is not controlled in these comparisons, so only trends are indicated.

For the South Unimak area, the pattern of daily landings has been highly variable, but catches for both species have been relatively low prior to about June 15, high between June 15-28, and lower thereafter (Fig. 1). For the Shumagin area, daily catch patterns have been even more variable, perhaps because it is a much smaller fishery and thus responds more quickly to changes in fishing effort.

In order to stratify the commercial harvest over time, ADFG has arrived at the following distribution of fishing effort:

Period	Allowable Harvest (%)	
	South Unimak	Shumagin
June 1 - 11	5	9
12 - 18	29	28
19 - 25	51	41
26 - 30	15	22
Total	100%	100%

These figures are an historical average of catch landings for the two fisheries, and they appear to be reasonable distribution of sampling effort based on apparent daily abundances of sockeye and chum in the two areas.

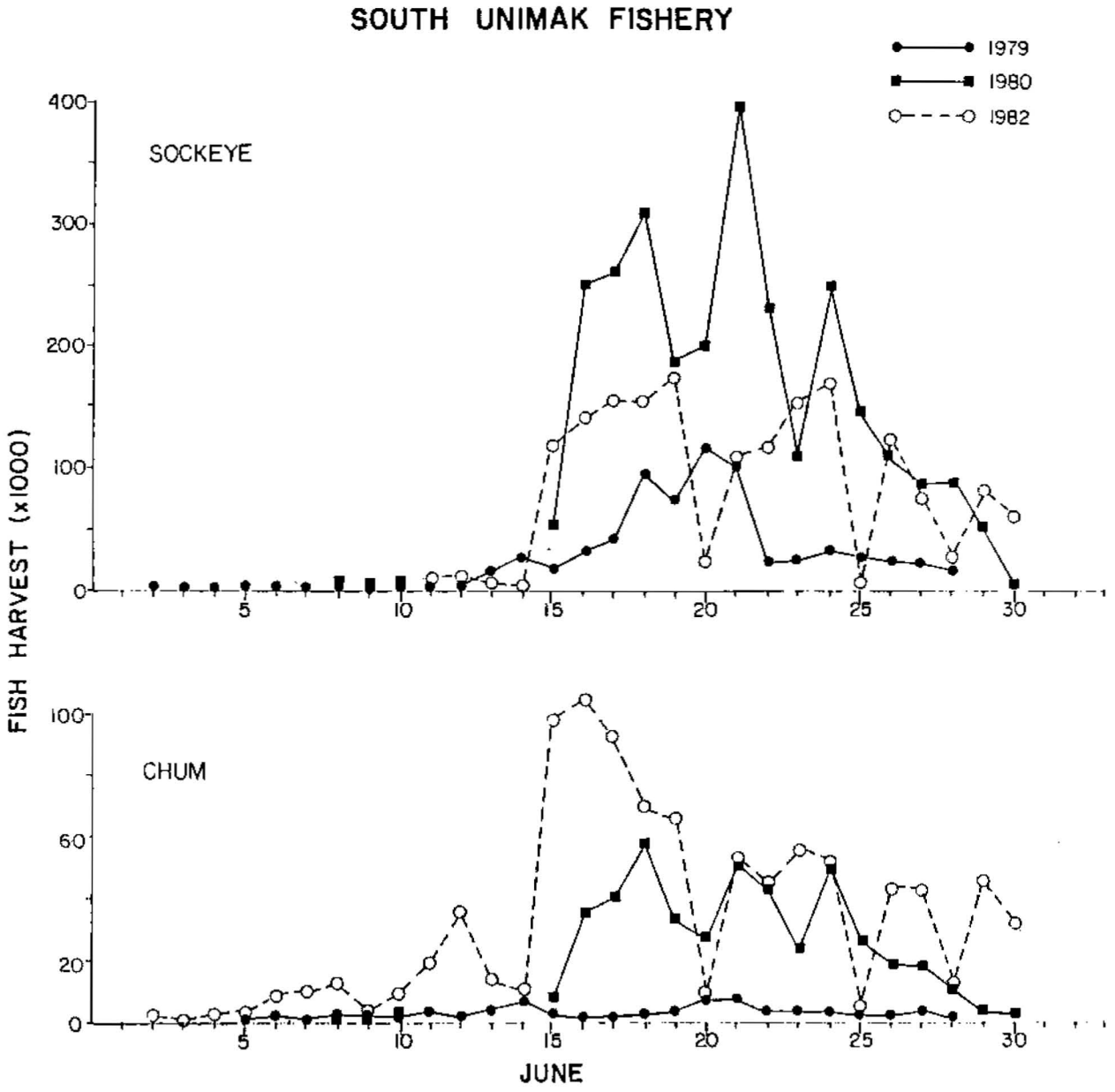


Figure 1. Daily commercial catches of sockeye and chum in the South Unimak fishery.

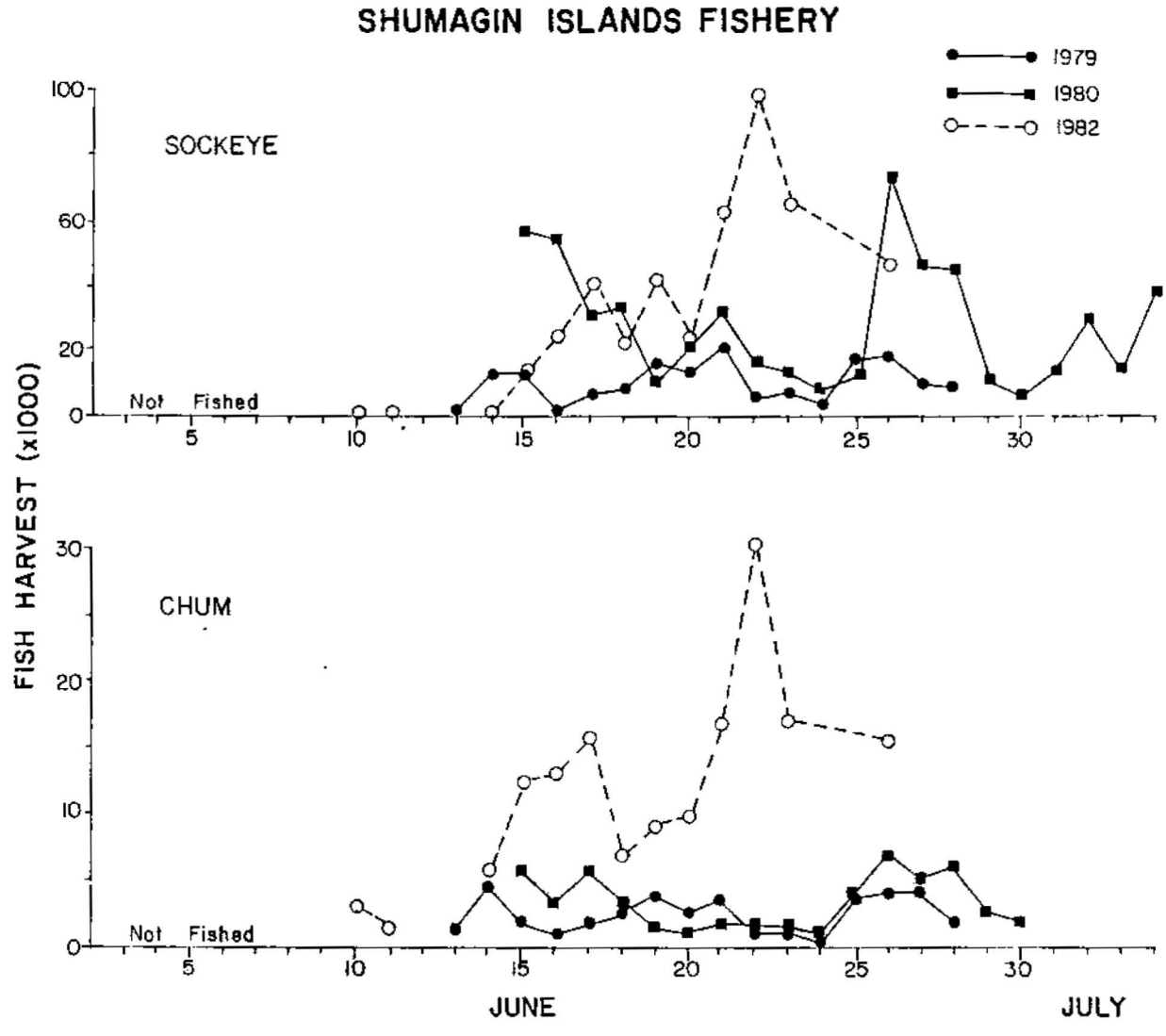


Figure 2. Daily commercial catches of sockeye and chum in the Shumagin Islands fishery.

The foregoing information provides a basis for the allocation of tags in the two fishing areas (Fig. 3, Table 1). In these calculations, we have slightly modified the 1987 allotment to account for tagging through the first week of July (i.e., 0, 1, 2, and 1%, respectively, of the allocation was subtracted from the first four periods and added to the fifth period).

From budgetary considerations (i.e., the cost of vessel charters), we calculate that 41 boat-days are available for tagging operations. These have been divided proportionally into weekly periods based on the number of tags needed and an estimated rate of tag application (Table 2). The tag application rate needed to achieve the goal of 25,000 tags is high. Mean application rates are 500 tags per boat-day in the Shumagin area and 641 tags per boat-day in the South Unimak area. Several factors suggest that these goals are achievable. First, application rates as high as 1000 sockeye per boat-day have been achieved by LGL in the International North Coast Salmon Tagging Program (which determined interception rate of salmon in S.E. Alaska and British Columbia). Second, we do not propose to measure each fish and we propose to take a scale sample from a subsample of sockeye (discussed later), therefore, time for tagging is maximized. Third, an additional 1-2 tagging days would be conducted both before and after June 30 if contingency funds had not yet been used. Other factors such as adverse weather and the strength of salmon runs are outside our control and may affect the tag application rate.

The 41 boat-days would be spent by four chartered vessels according to the proposed schedule of sampling effort shown in Table 3. It is recognized that this schedule must be flexible to accommodate actual dates of commercial openings. Close coordination would be maintained with the ADFG Regional Biologist regarding fisheries openings and closures.

Strategy

During the course of field tagging, it is likely that the limiting factor for meeting tagging goals will be the availability of chum salmon. Chum are much less abundant than sockeye and more chum than sockeye are to be tagged. Our strategy will therefore be to locate areas where chum are relatively abundant (e.g., Cape Lutke) and also communicate with the fishing fleet

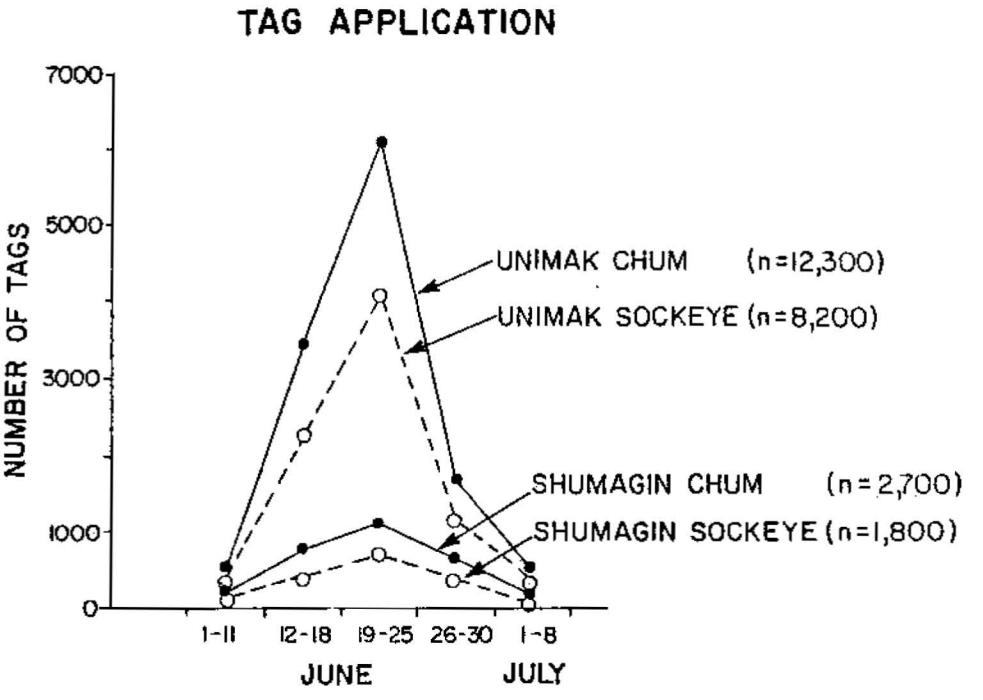


Figure 3. Weekly allocation of tags.

Table 1. Weekly allocation of tags.

Period	South Unimak Fishery					Shumagin Fishery				
	Allowable Harvest (%)					Allowable Harvest (%)				
	1986	1987*	Chum	Sockeye	Total	1986	1987*	Chum	Sockeye	Total
June 3-11	5	5	615	410	1025	9	9	243	162	405
11-18	29	28	3444	2296	5740	28	27	729	486	1215
19-25	51	49	6027	4018	10045	41	39	1053	702	1755
26-30	15	14	1722	1148	2870	22	21	567	378	945
July 1-8		4	492	328	820		4	108	72	180
	100	100	12300	8200	20500	100	100	2700	1800	4500

* potential extension into July

Table 2. Estimated number of boat-days needed for tagging.

	South Unimak Fishery			Shumagin Fishery		
	Total Tags	Estimated tags/boat-day	Boat-days	Total Tags	Estimated tags/boat-day	Boat-days
June 1-11	1025	512	2	405	405	1
12-18	5740	638	9	1215	608	2
19-25	10045	718	14	1755	585	3
26-30	2870	574	5	945	473	2
July 1-8	820	410	2	180	180	1
	20500		32	4500		9

Table 3. Schedule for tagging days in the Shumagin fishery area (S) and South Unimak fishing area (U). Shaded areas indicate potential dates of commercial fishing.

	JUNE																					JULY				
Boat	3	4	6	8	10	12	14	16	18	20	22	24	26	28	30	2	4	6	8
1			S				S		S		S	S		S		S		S	
2		U		U			U	U U U	U U	U	U U U	U U U		U U U	U U	U		U U	U
3								U U U	U U	U	U U U	U U U							
4											U U U	U U U							

regarding chum distributions after each commercial opening. In general, we expect that all chum salmon in each purse seine haul will be sampled first, followed by a subsample of sockeye, and excess sockeye will be released untagged.

Secondary Data

The highest priority of this project is to trace the origin of the salmon intercepted in the South Peninsula June Fishery. This is particularly true for chum salmon which have been the focus of controversy. We therefore feel that it is very important to collect scale samples from all tagged chum salmon because this information will add significantly to the tagging program. We will then have on file a scale sample for each tagged chum that is eventually recovered elsewhere in Alaska or Asia.

There are several advantages to this:

1. Scales from tagged chum salmon recaptured in their rivers of origin (i.e., escapement recoveries) often cannot be used for scale pattern analysis because scale margins are resorbed (Conrad 1984).

2. Because of this (No. 1 above), suitable scale samples may not be available for a particular stock until a year later when pre-escapement samples can be obtained.

3. Regardless of No. 1 or 2 above, the best scale samples for scale pattern analysis are those collected directly from the fishery to be examined.

In order to maximize the time available to tag as many fish as possible, we recommend that (1) measurements of fish lengths be deleted from the field programs and (2) scale samples from every other sockeye be collected. If needed, lengths could also be measured on a subsample of fish. Our electronic data base will, however, include fields for fish age and length, as stipulated in the RFP.

Quality Control

Previous experience in large-scale salmon tagging programs has lead to many quality control procedures, some of which are described later in 'Data Management and Processing'. In addition, quality control checks for tagging operations include:

1. Tags are first checked in the office (prior to release to the taggers) for missing, incomplete or illegible wording, and tag series given to field crews are recorded in office records.

2. Field crews are carefully instructed about tagging procedures and data recording.

3. Taggers re-check all tag release forms each evening to ensure completeness.

4. All forms are proof-read prior to data entry to ensure, for example, that tag numbers agree with the tag series provided to the vessel, etc.

TAG METHODOLOGY

The strategy of our tagging program is two-fold: (1) use key people who have previously participated in large-scale fish tagging program (see Personnel); and (2) use commercial seiners that have participated in the South Peninsula June Fishery and thus have a tested familiarity with salmon distributions in the study area.

Boat Charters

Two important factors determined our selection of boats to be used on this project: the level of funding and the relatively short duration of the salmon run in the study area. Both of these factors translate into the need to maximize tag application without having time to learn about the particulars of where and when to fish, the best site-specific seining techniques to use,

and so forth. For example, because sockeye are considerably more abundant than chum in the study area and because the tagging goal for chum is higher than for sockeye, tagging efforts will normally focus on catching and tagging the daily quota of chum salmon. Therefore, it is advantageous to the success of the tagging project to use boats familiar with these specific fisheries.

To accomplish this, we contacted each of the 120 fishermen holding a salmon seine permit in Region M (Alaska Peninsula/Aleutians). Most are local boats based out of Sand Point, King Cove and nearby locations. We have received 18 replies to date indicating their interest in participating in the project and their estimated charter costs. These estimates pertain to providing a boat and crew to catch and help tag the fish, as well as food and accommodation for the LGL Research Scientist.

The charters tentatively selected are listed in Table 4. The remaining offers provide us with back-up should a contingency arise.

Field Operations

Field operations will be based out of Sand Point where the Project Leader (P. Craig) will maintain a center of operations and management (probably at the Anchor Inn @ $575.00/month). Daily communication will be made with the taggers (by VHF or single side band radio on a pre-arranged schedule) to monitor progress in meeting tagging goals. Daily and cummulative numbers of tags applied will be charted to determine whether any reallocation of tagging effort is needed.

Tag Application

Manpower aboard each tagging vessel will consist of the boat's crew of 5-6 people and one LGL Research Scientist or Technician. The duty of the LGL person will be to oversee tagging operations (quality control) and record data. After proper instruction and practice, the ship's crew will do the actual fish tagging. This method has worked well in our previous salmon tagging projects. Crew members are able to accomplish this task easily and proficiently.

Table 4. Purse seine charters.

Seiner	Size (ft.)	Owner	Site Fished	Daily Charter
Patience	52	D. Foster	Shumagin	$1,300
Miss Juli	58	S. Lovejoy	Both	$1,450 - $1,750
Temptation	58	M. Larson	Unimak	$1,800
Ms. Ingrid	58	D. Jacobson	Both	$2,000
Backup				
Miss Brenda	58	J. Holmberg	Shumagin	$1,495
Champion	58	C. Galovin	Shumagin	$1,750
Lisa Ann	47	V. Wilson	Unimak	$2,000
Aleutian Belle	58	N. Larson	Both	$2,000
plus 10 more boats				

Sockeye and chum salmon will be caught by purse seine in areas where the commercial fishery operates. Tagging operations will occur during fishery closures. Based on the schedule of fishery openings in recent years and the predicted low return of Bristol Bay sockeye in 1987 (ADFG 1986), the South Peninsula June Fishery is expected to be open about one day a week, thereby facilitating tagging operations between openings.

The seiners will fish as they would do in the fishery in order to make the tagging effort reflect the actual harvest in this fishery. In the event, however, that catches are higher than can be effectively tagged, (a) excess fish will be released to minimize unnecessary holding time, and (b) set times will be shortened.

After the seine has been pursed and drawn up next to the boat, the bag will be kept open (so that the fish are not injured) by poles or by using the seine skiff for this purpose. Individual fish will then be brought aboard using long-handled dipnets. Wool mitts will be worn by the handlers to secure a firm grasp on the fish and reduce slippage.

The fish will be placed in a V-shaped wooden tagging box for holding while it is tagged. As previously discussed, scale samples will be collected from all chum salmon and every second sockeye salmon. The "preferred scale" will be taken (i.e., left side of fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin). If this scale is missing, a scale will be taken from the "preferred area" (area behind the dorsal fin, in front of the anal fin, but not more than four rows above the lateral line). Scales will be put on pre-labeled gummed cards.

A spaghetti tag (12") will be used to tag the fish. Tags will be individually numbered and labeled with a return address (described in the next section). To reduce the possibility of tagging and recording errors, one tag color and number series will be used for chum salmon and another for sockeye salmon. The tags are threaded on a steel needle and drawn through the back of the fish below and just behind the dorsal fin. A square knot is used to secure the tag. Only fish in good condition will be tagged and released.

Following each sampling effort, the following data will be recorded on a standardized waterproof field form: date, vessel, tagger, location, set time, set number, number of fish tagged, and series numbers of tags used (Fig. 4).

TAG RECOVERY

There are two basic approaches to maximize information derived from a passive recovery program: (1) increase publicity of the recovery program; and (2) increase the number of tags put on the fish. We have previously described our efforts to tag as many fish as possible. Recovery efforts will include extensive publicity of the program in western Alaska, Asia and Canada, as well as a lottery to encourage tag returns.

General Features

Each tag will bear a unique number and return address which will be the LGL office in Juneau, Alaska. We will also attempt to put a Japanese address on the tags. Floy Tag Company advise that this is possible given adequate lead time. Japanese is recommended over Russian wording because far more chum salmon are presently caught and originate in Japan than Russia (Shepard et al. 1985).

A publicity flyer (Fig. 5) will be made to describe the goals of the tagging program, request that tags be returned (together with information about recapture date and location), and announce that recaptured tags will be entered in a lottery, with three draws, each worth $500. Based on our experience with several tag return lotteries (conducted in conjuction with the International North Coast Salmon Tagging Program), we anticipate that a lottery will stimulate a tag return effort on the part of the public. It is more effective than a fixed price per tag return and it has the added attraction that it is a fixed cost in our budget. The lottery will be conducted on or about the termination of this project (September 30, 1977).

The inscription on each spaghetti tag will include mention of the lottery (e.g., "$500 lottery") to promote tag returns.

TAGGING STUDY: Tagging Form

Date ☐☐☐☐☐☐ (M M D D) Tagger(s) _____

Vessel _____ Set Time ☐☐☐☐ (START) ☐☐☐☐ (END) (H H M M)

Set No. ☐☐☐☐

Saltwater Stat. Area	Sub Area	

Specific Location: _____

_____

Lat. ☐☐☐☐☐☐☐ (D D D M M S S) Long. ☐☐☐☐☐☐☐ (D D D M M S S)

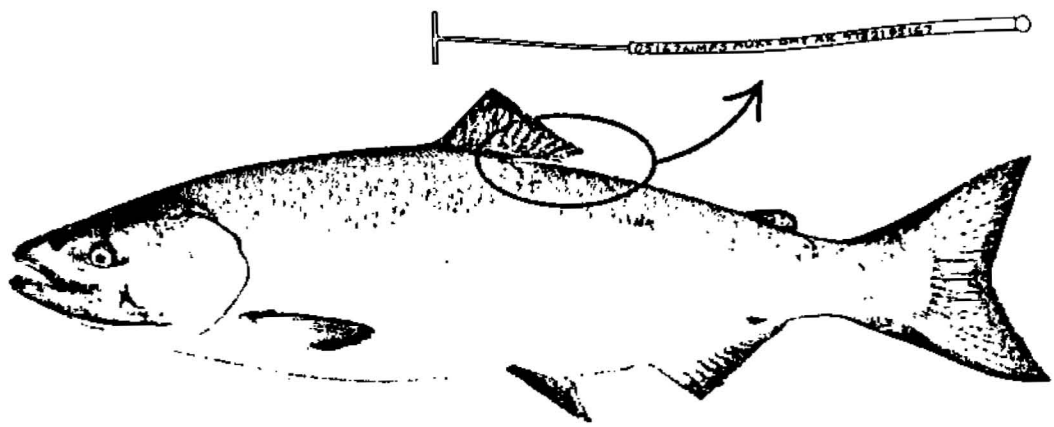
SOCKEYE			CHUM		
Start	End	Total	Start	End	Total

Figure 4. Sample of tagging form.

ATTENTION SALMON FISHERMEN

The Auke Bay Laboratory of the National Marine Fisheries Service is engaged in research on king salmon and coho salmon in southeastern Alaska. In 1984-1985, over 2,500 king salmon and 500 juvenile coho salmon were externally tagged below the dorsal fin with 2½ inch long, grey plastic, tubular tags. This tagging is continuing in 1986. Tag recoveries provide us with valuable information on the distribution, migration patterns, residency times, and growth of these species in the marine waters of southeastern Alaska.

We urge commercial and sport fishermen to look for these grey, tubular, plastic tags on the king and coho salmon that they land, and to return the tags to the Auke Bay Laboratory.



Useful information to include with the tag: date and location of capture, type of fishing gear, length from tip of snout to fork of tail, weight, sex, stage of maturity, and your name and address so that we can provide you with background information on the tagged fish.

THANK YOU!

Auke Bay Laboratory
P.O.Box 210155
Auke Bay, Alaska, 99821

Figure 5. Sample publicity flyer.

Another general feature of our recovery effort is that all salmon caught by the tagging boats will be inspected for other tags, including the missing adipose fins of nose-tagged fish. Heads from the latter will be retained.

Regional Publicity

Western Alaska

Information about the tag and recovery program would be broadcast throughout western Alaska in two ways. First, user groups can be contacted directly via computerized listings of licensed fishermen (n = 5500 in western AK) which are maintained by the ADFG Limited Entry Commission (Juneau). Mailing labels for these fishermen can be purchased for $97.00. We propose to mail the information flyer to 2-10 addresses in every community listed. Similarly, computerized listings of fish buyers are maintained by ADFG Computer Services (Juneau). Flyers would be sent to these buyers and also Post Offices in western Alaska. ADFG itself would also be an important distributor of information through its varied field operations.

The second way to broadcast information that we propose is to write a brief community service article for publication in west coast fish magazines:

1. Pacific Fisheries Review: The Fishermen's News C-3 Building, Room 110, Fishermen's Terminal, Seattle, WA 98119.

2. Alaska Fisherman's Journal, 1115 NW 46th St., Seattle, WA 98107.

3. The Fisherman, 160-111 Victoria Drive, Vancouver, B.C. V5L 4C4.

Because the recovery of tags is beneficial to those who find them (i.e., the recovery of tags in "your" stream shows that the South Peninsula June Fishery was intercepting "your" salmon), we anticipate that the above journals will be interested in covering the study. Similarly, the National Public Radio network in Alaska hosts a weekly show about Alaska's fisheries. This newscast would be an appropriate outlet for the tagging study. Another natural contact point would be the Alaskan Fishermen's Union.

Asia

Contact with Asian countries would be principally through their own fisheries agencies. In Japan the lead agencies would include the Far Seas Laboratory of the Japan Fisheries Agency (Shimizu) and the Overseas Fishery Cooperation Foundation (Tokyo). In the USSR, we would coordinate activities through TINRO (Vladivostok) as is currently done with high seas tagging programs (Fisheries Research Institute, University of Washington). Other contacts that will be pursued include:

1. Alaska Department International Trade, which maintains offices in Tokyo and Seoul.

2. Senators Stevens and Murkowski, regarding liaison and contacts.

3. Edward Wolfe, Deputy Assistant Secretary of State for Oceans and Fisheries Affairs, regarding foreign fish catches.

4. The U.S. Embassy in Tokyo, John Giesberg (Fishery Attache).

Canada, Washington

The prime means of tag collection in Canada and Washington would be through LGL's existing communication network which is part of the on-going International North Coast Salmon Tagging Program. In addition, the previously mentioned trade magazines are also directed at these audiences.

High Seas

Although some tags may be recovered from high seas fisheries, many will not be directly useful to the present project because their source rivers will remain undefined. Therefore, we do not envision publicity for these fisheries beyond informing NMFS's Foriegn Observer Program and the previously-mentioned foriegn fisheries agencies.

Other

Other organizations that would be informed of the program include:

1. North Pacific Management Council (Anchorage).
2. International North Pacific Fisheries Commission (Vancouver).
3. International Pacific Salmon Commission (Vancouver).
4. Fisheries Research Institute (Seattle).
5. National Marine Fisheries Service (Anchorage, Juneau, Seattle).

DATA MANAGEMENT AND PROCESSING

The flow of information will be partitioned into three sub-systems as shown in Figure 6: (1) data recording; (2) data entry: and (3) construction of the final database. The implementation of these sub-systems is described below:

Data Recording

Tag Release Procedures

Figure 7 shows the proposed flow of information related to tag releases. Tag sequences will be allocated to boats and the allocations recorded. Taggers will complete a tag release form for each set which will be brought back to the data center in Juneau. In addition, taggers will be required to complete personal logs of sets and tags released.

In Juneau, the release form will be visually checked for obvious errors such as a duplicate release of a single tag number. Following entry of data to the computer system, forms will be filed and cross-referenced by computer record number to allow later verification.

Tag Recovery Procedures

The handling of raw tag recovery will largely resemble that of release data except that information from a large number of different sources is anticipated (see Fig. 6).

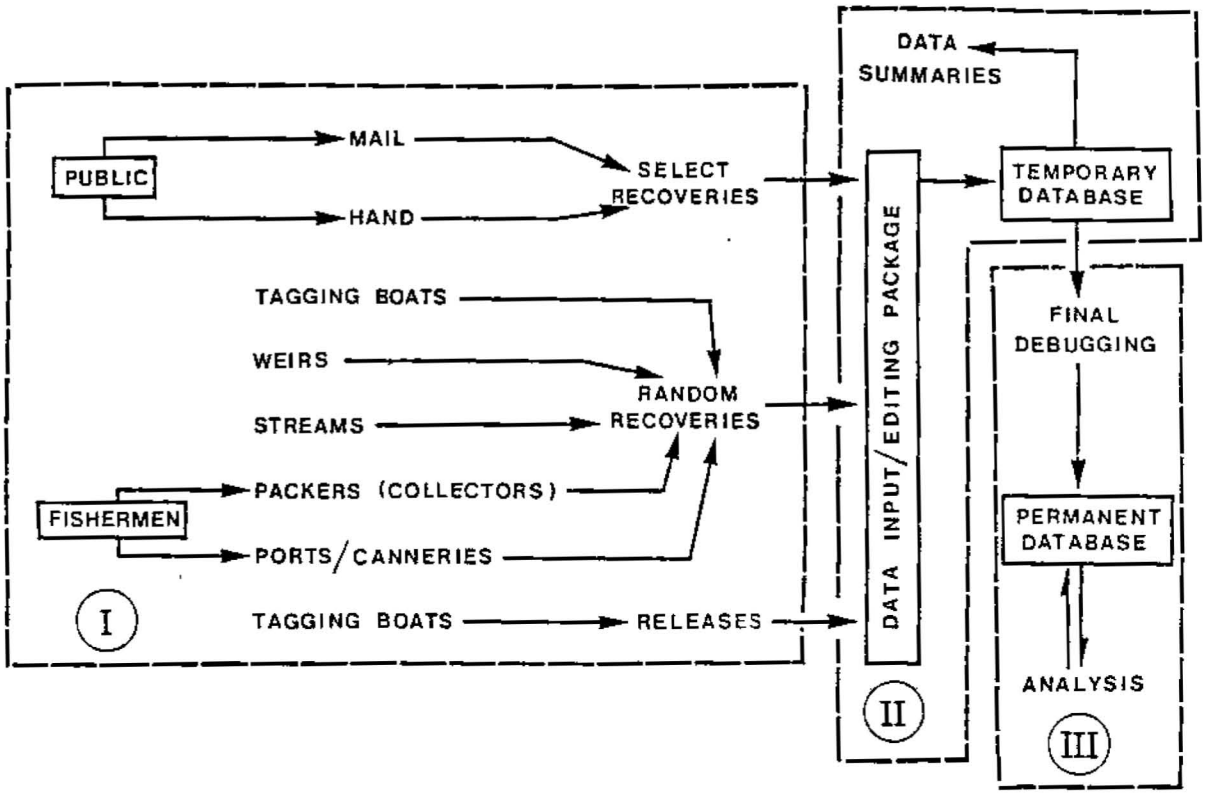


Figure 6. Flow of information in the North Coast Salmon Tagging Study. In the proposed project, all recoveries would be categorized as "select recoveries" in this chart.

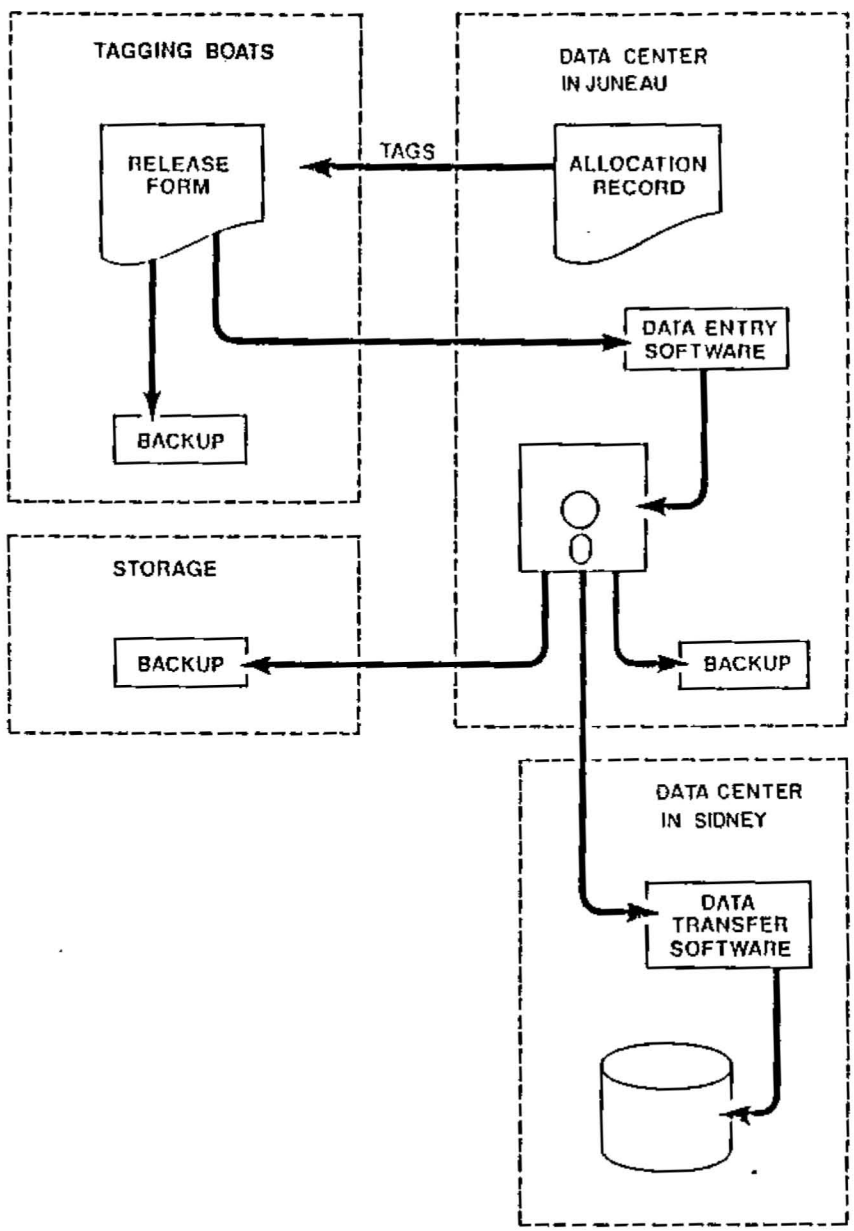


Figure 7. Flow of tag release data.

Data Entry

Compilation of an error free database is greatly facilitated by checking routines built into the data input package. Over the course of the four years comprising the North Coast Salmon Tagging Study, a number of sub-routines were installed and refined in the input software. Since writing and debugging such routines is a time consuming and potentially difficult task, we propose to use the data input packages from the North Coast Salmon Tagging Study in a suitably modified form, for the present study.

All data will be entered onto 5.25 inch soft diskettes using specially designed software on Apple IIE microcomputers.

The structure of the databases to be maintained on the Apple IIE is shown in Figure 8. Data will be entered using input-editing software which formats the monitor screen to resemble the relevant form. When a datum is entered, the software will check it for a series of errors that indicate consistency with other parts of the form. If an error is detected, then a suitable message is displayed and the datum must be re-entered correctly. If no error are detected, then the datum is displayed at the appropriate place on the screen.

Once entered, the same software used for entry can be used to "call-up" any recorded (form) and to make changes to any field of that record.

Finally, format conversion routines will be used to convert the data from the random access format used by the input/editing route to a sequential format suitable for transfer to a VAX mainframe. Records can then be sorted by species, length, age, date of tagging, locality of tagging, and tag number.

Database Construction

The final database will be constructed on the VAX/VMS system at LGL's Sidney office in British Columbia. A network approach, where releases and recoveries are connected by pointers will be taken in structuring the data-

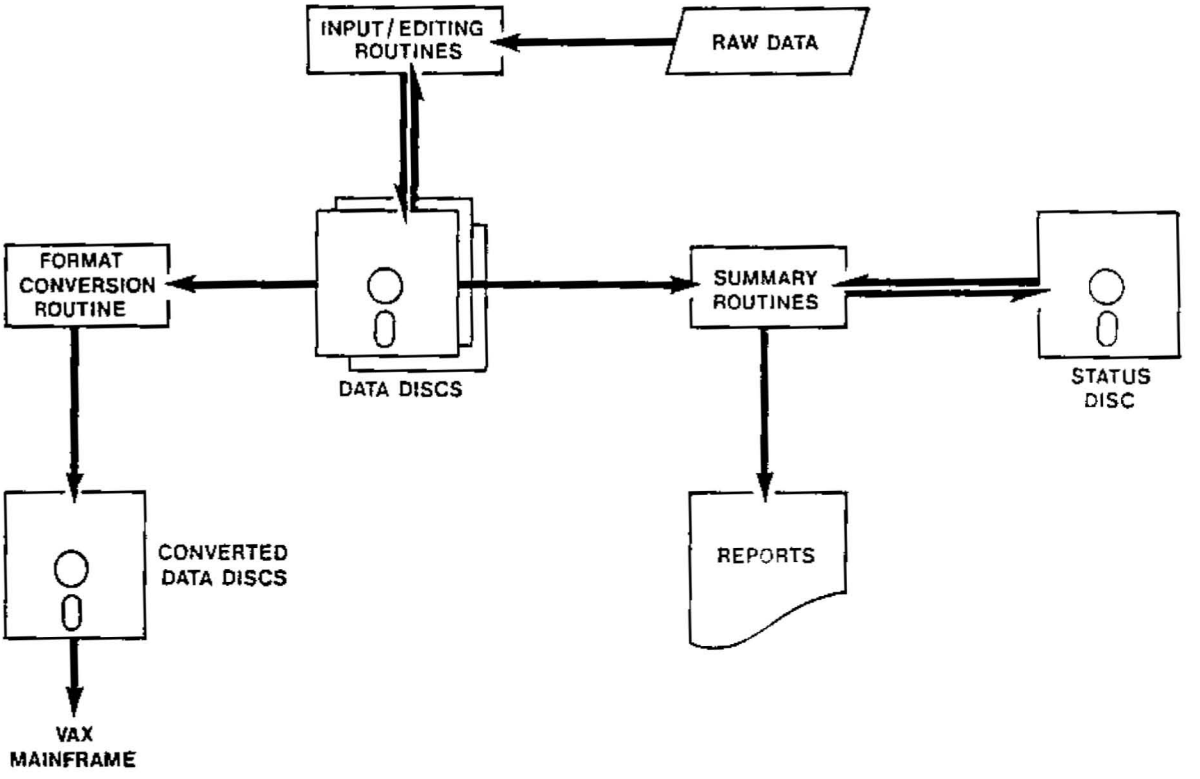


Figure 8. Structure of temporary databases used for release, recovery and lottery data on an Apple microcomputer.

base. This format has previously been used to compile the much larger databases from the North Coast Salmon Tagging Study and can be easily adapted for this program.

Figure 9 depicts the sequence of events leading to the construction of the database. Data will be received from Juneau in the converted format on 5.25 inch Apple disks. As disks are completed and received in Sidney, information will be transferred onto the VAX/VMS system using the Modem Magic Package. The information from each disk will then undergo three processes:

1. checks for internal consistency -- ensuring that no tags are released/recovered more than once;

2. checks for consistency with the database -- ensuring that release/recovery information does not clash with information already in the database; and

3. addition to the database -- connecting the data with the necessary pointer chains.

Few errors are anticipated during the consistency checking phase, due to the sophistication of error checking routines in the input software and relatively small number of tag releases and expected recoveries. Any errors that do occur can likely be resolved by examining the records of tags allocated to boats and the personal records of taggers.

Analytical programs will be run on the VAX database. Subsequently, a file transfer routine will convert the data into a form suitable for acceptance by RBASE 5000, run on an IBM PC. This will be the final format for delivery to ADFG at the conclusion of the program.

Data Processing

A major benefit will result from the use of the VAX mainframe is the ability to utilize existing programs for data processing.

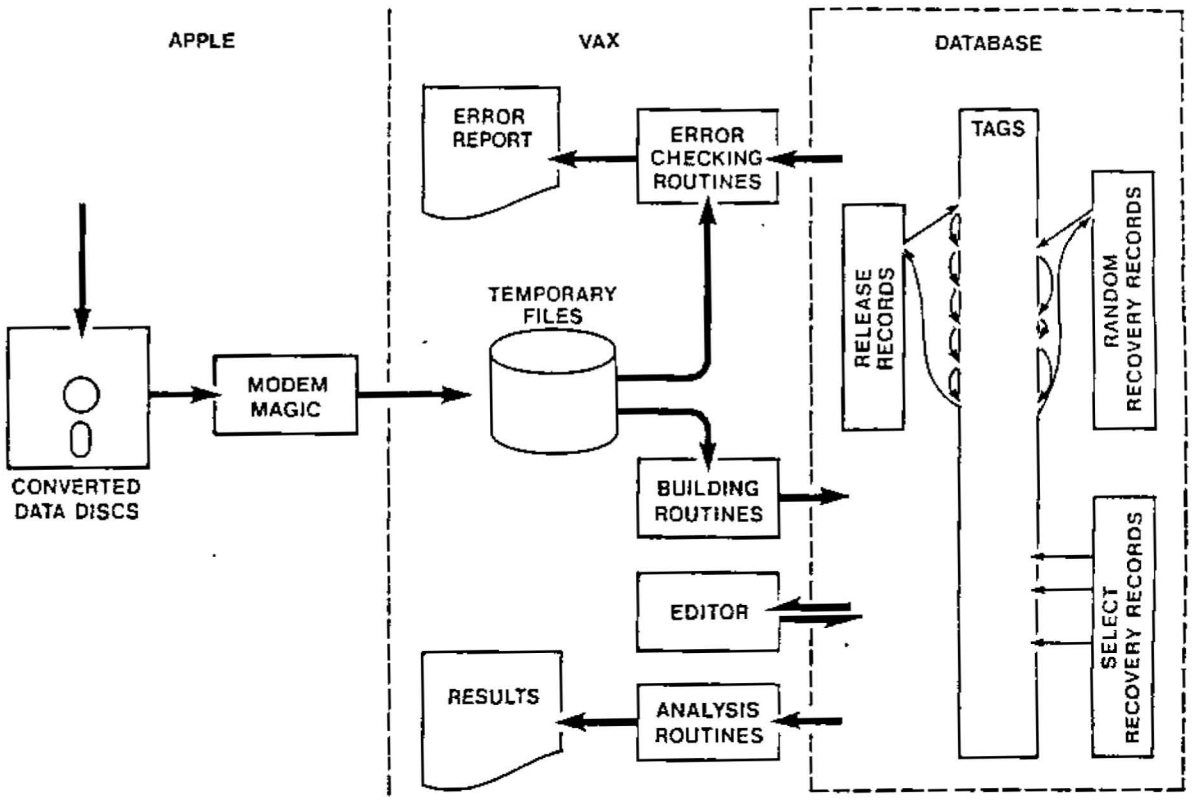


Figure 9. Structure of databases and data handling routines on the VAX computer for the North Coast Salmon Tagging Study. In the proposed study, all recoveries would be categorized as "select recovery records" in this chart.

Data processing programs developed in 1982 and modified in subsequent years will be used to search the database for the following inconsistencies:

1. recovery dates prior to release dates;
2. tags recovered with no record of release; and
3. tags released outside designated tagging area.

In the process of checking for these inconsistencies, the data will be edited and summarized in preparation for analysis.

Summary Data Files

Existing programs will be modified to maximize information from the database. Data summary program are designed to scan the database and store release and recovery information in three arrays which are written to an unformatted file upon completion. Unformatted files are the most efficient way to store and retrieve summary data. The unformatted files can include summaries of release numbers for each combination of species, week and location; and recovery numbers for each combination of release location, recovery location, week, gear type and species. Such files can eventually be used to produce summary tables for the report.

PROJECT REPORT

Three products of this study will be submitted on or before the termination of the project (September 30, 1987): (1) a report, (2) a database using RBASE 5000, and (3) scale samples from tagged fish. The report will consist of a project description including objectives, methods, results and discussion. Summary statistics will include the weekly number of tags applied to chum and sockeye in the two fishery areas, the geographic distribution of tag recoveries by week of release,the mean number of days at large between release and recovery data for fish caught in major geographic regions, and graphics illustrating geographic patterns of recovery. A discussion of these results will include a comparison with earlier tagging studies (i.e., Thorsteison and Merrell 1964, Brannian 1984), and for reference purposes, a comparison of the 1987 commercial harvest level with previous years' catches.

ANTICIPATED PROBLEMS

1. Adequate lead time is needed to initiate several parts of the program: (1) order tags (Floy Tag Company estimates a 2 month delivery time); (2) contract boats; (3) initiate publicity of the recovery program; and (4) secure accommodation in Sand Point.

2. The tag application rate may be reduced by factors beyond our control such as weather or the timing and strength of fish migrations.

3. Some recovered tags may be received long after the termination of this project (September 30, 1987); however, we anticipate that the receipt and entry of these tags (by LGL or ADFG) into the database will cause no significant problem.

KEY PERSONNEL

Key personnel are Peter Craig (Project Leader) and Dave Schmidt (Crew Chief). Their resumes are provided in Appendix 1.

Project Leader: The proposed Project Leader is **Dr. Peter Craig.** He will be responsible for all phases of the tagging project, including both field and office management. He will initiate publicity of the tagging project, coordinate field efforts from a base of operations in Sand Point, assist with tagging, supervise data entry procedures, and prepare a final report for the study. Dr. Craig maintains an LGL branch office in Juneau, thereby facilitating day-to-day liaison with ADFG headquarters.

Dr. Craig has conducted fisheries research in Alaska since 1970. For the past 10 years, he has focused on studies of coastal fishes, including the Bering Sea (adjacent to the study area for the proposed project). In this MMS/NOAA study, he examined fish use of nearshore waters on the north side of the Alaska Peninsula from Unimak Pass to Port Moller. On another recent project for MMS/NOAA, he conducted a literature review of all fisheries information available for the Unimak Pass area.

Dr. Craig has participated in several fish tagging projects, the most pertinent of which was the 1982 International North Coast Salmon Tagging Study. The purpose of this joint U.S.-Canadian study was to determine interception rates of salmon by various fisheries along the Pacific coast. Dr. Craig was the overall field coordinator for the Canadian segment of this project, which at peak periods involved the supervision of 50 field technicians and biologists who were tagging salmon on 15 chartered vessels and recovering tags in canneries, stream surveys, packer boats and weirs. Additional office staff entered tag and recovery data daily. During this project, 100,000 salmon were tagged and released.

Dr. Craig has recently published a paper on stock identification of sockeye salmon in the Stikine River (see resume).

Crew Chief: Because tagging operations will occur in two widely separated areas, we feel that it is essential to have an experienced fisheries biologist on both tagging grounds. Peak tagging for the project will occur during mid-June when boats in the South Unimak area may remain at sea for 1-2 weeks as they participate in both commercial fishing and tagging activities. Therefore, with P. Craig in the Shumagin area, we propose to use **Dave Schmidt** as the on-site Chief in the South Unimak area.

Mr. Schmidt has conducted fisheries research in Alaska since 1980. He has been the Crew Chief on several fish tagging studies in the Beaufort Sea and has also participated as Chief Scientist on two cruises of the Miller Freeman in the Unimak Pass area of the Bering Sea.

Data Management: Bill Gazey, M.Sc. and Karl English, M.Sc. of LGL Limited have had key roles in the development of the North Coast Salmon Tagging Study in Canada. One product of their program design and modelling applications is a tested system of data management and processing for large-scale salmon tagging projects. Mr. Gazey and Mr. English will supervise the data management of present project.

Field Technician: The schedule of tag application requires four taggers during the peak period of the salmon run. In addition to P. Craig and D.

Schmidt, two technicians will complete the tagging crew. The technicians will receive thorough instruction and will be supervised by the Project Leader and the Crew Chief.

CORPORATE EXPERIENCE

LGL is a joint venture of three small business corporations, LGL Alaska Research Associates, Inc. of Anchorage, Alaska (LGL Alaska), LGL Ecological Research Associates, Inc. of Bryan, Texas (LGL Texas) and LGL Limited, environmental research associates of Toronto, Canada (LGL Limited). Each of the parent corporations is independently owned and operated, managed by its own officers and directors, and conducts many projects that do not involve the other corporations. However, the joint venture arrangement allows the group to draw on the most appropriate resources from each entity to construct a project team. For simplicity, the contracting is done by one of the three entities.

LGL conducts environmental research on behalf of clients in industry and government. When retained as contractors, LGL recommends the type and extent of research that is desirable or necessary to evaluate matters of environmental concern or meet the requirements of regulatory bodies. When a program of research has been agreed upon, LGL follows state-of-the-art scientific procedures to ensure that the conclusions derived will withstand professional, governmental, and public scrutiny.

The most pertinent studies that LGL has conducted relative to the proposed project include several large-scale tagging project and recent experience in the Bering Sea. Descriptions of these studies follow.

1. **North Coast Salmon Tagging Project:** In 1985 LGL completed the fourth year of the largest adult salmon tagging project ever conducted on Pacific salmon. The project was designed to provide accurate estimates of interception rates of international salmon stocks by Alaskan and Canadian commercial fisheries; commercial fishing vessels were chartered for the tagging program and fish were tagged with Peterson disks or spaghetti tags. Up to 100,000 salmon were tagged during

some years of this project. A key feature of this program has been the requirement that salmon are tagged in a constant proportion throughout their run. This has necessitated a rigorous experimental design coupled with on-site monitoring of tag application on a daily basis.

2. **North Aleutian Shelf Ecosystem Study (Bering Sea):** In 1984-85 LGL conducted a multi-disciplinary study of the nearshore zone (0-50 m) along the Alaska Peninsula (Unimak Pass to Port Moller). This MMS/NOAA study focused on key fishes, seabirds and marine mammals inhabiting the nearshore zone, and the physical and biological processes that contributed to the biological productivity of the area. Component studies included oceanographic processes, major sources of carbon for the food web, the flow of energy through consumers in the system, and the distributions and food habits of important vertebrate species.

3. **Unimak Pass: a Synthesis of Information:** LGL recently completed a review of available information describing biological resources in Unimak Pass and the eastern Aleutian Islands. The fisheries portion of this MMS/NOAA study described use of the region by local and non-local stocks of salmon.

4. **Prudhoe Bay Waterflood Fish Monitoring Program:** LGL has conducted several large-scale tagging studies to determine the effects of changes in the water temperature and salinity regimes on the distribution and movement of anadromous and marine fishes around the Prudhoe Bay causeway. Studies were conducted throughout the open water season (1981-82) using a combination of tagging data, captures of fish in fyke nets and gill nets, and hydroacoustic techniques.

5. **Population Dynamics of Commercial Shrimp Species:** On behalf of the U.S. National Marine Fisheries Service, LGL conducted a major study of the commercial shrimp fishery in the northwest Gulf of Mexico. The study involved a major tagging effort (over 90,000 shrimp marked) and a series of cruises to determine the spawning sites of the

various subpopulations revealed by the tagging results. The final report included an analysis of the population dynamics of the species and the sustainable yield in relation to commercial harvests.

PROJECT BUDGET

Cost information for Part 1 (through June 30, 1987) and Part 2 (July 1 - September 30, 1987) of the South Peninsula Tagging Study are presented on the following pages. These costs provide for the charter of purse seine vessels and crew for capture of salmon, as well as technical personnel for tagging, recording and tabulation of tagging and recovery data in electronic format. Office overhead is included in charge-out rates for personnel.

PHASE 1 BUDGET (through June 30, 1987)				PHASE 2 BUDGET (July 1 - September 30, 1987)	
Personnel (includes overhead)					
	rate	days	totals	days	totals
Craig	390	38	14820	32	12480
Schmidt	315	24	7560	15	4725
Tagger -1	150	26	3900		
Tagger -2	150	9	1350		
Data Manager	400	1	400	7	2800
Data Technician	200	0		20	4000
			28030		24005
Disbursements					
4 return flts./misc. AK-Sand Point			2900		1000
3 return flts./Sand Point-King Cove			400		200
Field accommodation @ $575.00/month			575		400
Food - 38 days @ 30/day			1140	8	240
Floy spaghetti tags (25,000)			6375		
Misc. gear (dipnets, etc.)			1200		
Communications			600		800
Report prep./production					1600
Publicity (flyers, postage, etc.)			1350		1800
Tag lottery - 3 @ $500.					1500
Boat Charters					
Boat 1 - 7 days @ $1300/day			9100	2	2600
Boat 2 - 15 days @ $1750/day			26250	4	7000
Boat 3 - 9 days @ $1800/day			16200		
Boat 4 - 4 days @ $2000/day			8000		
Contingency			2380		4155
			104,500		45300
	10% fee		10450		4530
	TOTAL		$114,950		$49,830

LITERATURE CITED

ADFG (Alaska Dept. Fish and Game). 1986. Bulletin 8(7):1-6.

Brannian, L. 1984. Recovery distribution of chum salmon (Oncorhynchus keta) tagged in the North Pacific offshore of the Alaska Peninsula and eastern Aleutian Island chain. Alaska Dept. Fish and Game, Info. Leaflet No. 237. 30 p.

Conrad, R. 1984. Separating stocks of western Alaska chum salmon using scale pattern analysis. Alaska Dept. Fish and Game. Rep. to the Board of Fisheries.

Shaul, A., J. McCullough and L. Malloy. 1984. 1984 salmon and herring annual report, Alaska Peninsula - Aleutian Islands areas, Alaska Dept. Fish and Game, Div. Comm. Fish. 191 p.

Shaul, A. 1986. Alaska Peninsula-Aleutian Islands management area. Salmon report to the Alaska Board of Fisheries. Alaska Dept. Fish and Game. 25 p.

Shepard, M., C. Shepard and A. Argue. 1985. Long-term trends in the contributions of salmon from different geographical areas to the commercial fisheries of the North Pacific. Can. Tech. Rep. Fish. Aquat. Sci. No. 1376. 52 p.

Thorsteinson, F. and T. Merrell. 1964. Salmon tagging experiments along the south shore of Unimak Island and the southwestern shore of the Alaska Peninsula. U.S. Fish and Wildl. Serv., Special Scien. Rept. - Fish. No. 486. 15 p.

APPENDIX 1: Resumes of Key Personnel

PETER C. CRAIG, Ph.D.
Senior Fisheries Biologist

EDUCATION

1973	Ph.D., Biology, University of California, Santa Barbara.
1969	M.A., Biology, University of California, Santa Barbara.
1967	B.A., Biology, Stanford University, California.

PROFESSIONAL EXPERIENCE

1984-Present — Affiliate Associate Professor of Marine Science, University of Alaska, Fairbanks.

1977-Present — Senior Fisheries Biologist, LGL Alaska Research Associates, Inc. Supervisor of marine and freshwater research in Alaska. Project director/principal investigator of numerous fisheries studies in Alaska and Canada. Research includes: ecological processes studies in coastal lagoons, habitat use by fish in streams, lakes and coastal waters, migrations, trophic and life history analyses, inventories, toxicity experiments and impact assessments such as the effects of pipelines, dams, dredging and offshore developments on fish populations (see Selected Project Experience and Publications). Participant at seven government sponsored synthesis meetings regarding the environmental effects of petroleum-related activities in the Alaskan coastal waters.

Coordinator of Canadian segment of the International North Coast Salmon Tagging Program which determined proportions of salmon stocks intercepted by U.S. and Canadian fisheries adjacent to the Alaskan/B.C. border. This program involved the direction of 55 technicians and supervisors in a large-scale tagging program for sockeye and pink salmon, followed by a stream recovery program and monitoring of the commercial fishery.

1972-77 — Senior Aquatic Biologist, Aquatic Environments, Ltd., Calgary, Alberta. Position involved original fisheries research, administration, and consulting in aquatic biology. Conducted ecological studies of arctic aquatic resources, directed field crews, and assessed environmental impact of a proposed gas pipeline. Specific projects are indicated by report titles (see Publications).

1970-72 — Fisheries Consultant, Alyeska Pipeline Service Company, Bellevue, Washington. Conducted ecological studies of fish and stream invertebrates on Alaska's North Slope and assisted in assessing environmental impact of the Trans Alaska Pipeline.

PETER C. CRAIG

PROFESSIONAL EXPERIENCE (cont'd)

1967-73 Graduate research involved ecological studies of several species of intertidal invertebrates inhabiting sandy beaches (see Publications).

PUBLICATIONS

Dr. Craig has written over 50 publications and research reports which are listed on supplementary pages.

SELECTED PROJECT EXPERIENCE

NOAA/OCSEAP

Serve as chairman of fisheries and interdisciplinary working groups in synthesis meetings evaluating existing information and environmental impacts related to oil and gas developments in the Bering, Chukchi and Beaufort seas. Prepare review articles for fish and invertebrates.

Conduct a four-year field program which examined ecological processes operating in a lagoon-barrier island ecosystem of the Beaufort Sea, with particular emphasis on the role of fishes during winter and open-water seasons.

Principal investigator of fishes in a multidisciplinary study of the nearshore zone of southern Bristol Bay (North Aleutian Shelf).

International Northcoast Salmon Tagging Program

Coordinator of Canadian segment of largest salmon tagging and recovery program ever conducted in northern Pacific coastal waters.

North Slope Borough (Alaska)

Detailed study of fishes in freshwater and marine habitats of the Chukchi Sea. Examination of dredging programs at five North Slope villages to insure protection of fish resources and subsistence fisheries.

Trans Mountain Tanker Route

Inventory of major fish resources along coast of British Columbia and impact assessment of potential oil spills on fisheries.

B.C. Hydro

Project director of major inventory and impact study of proposed hydroelectric developments in the Liard River drainage.

PUBLICATIONS

Craig, P.C. 1987. Adaptations of anadromous fishes to the arctic environment. Biol. Papers University Alaska. (in press).

PUBLICATIONS (cont'd)

Craig, P.C. 1985. Identification of sockeye salmon stocks in the Stikine River based on egg size measurements. Can. J. Fish. Aquat. Sci. 42:1696-1701.

Craig, P.C. and L. Haldorson. 1986. Pacific salmon in the North American Arctic. Arctic 39:2-7.

Craig, P.C. 1984. Fish use of coastal waters of the Alaskan Beaufort Sea: a review. Trans. Am. Fish Soc. 113:265-282.

Craig, P.C., W. Griffiths, L. Haldorson and H. McElderry. 1984. Fish composition and distribution in an Alaskan Arctic lagoon. Polar Biology. 4:9-18.

Craig, P.C., W. Griffiths, S. Johnson and D. Schell. 1984. Trophic dynamics in an Arctic lagoon. p. 347-380. In: P. Barnes, E. Reimnitz, and D. Schell (Eds.), The Alaskan Beaufort Sea - Ecosystems and Environments. Academic Press.

Gallaway, B.J., W. Griffiths, P.C. Craig, W. Gazey and J. Helmericks. 1984. An assessment of the Colville River delta stock of Arctic cisco (Coregonus autumnalis)--migrants from Canada? Biol. Papers of the Univ. Alaska (Fairbanks). 21:4-23.

Haldorson, L. and P.C. Craig. 1984. Life history and ecology of a Pacific-Arctic population of rainbow smelt, Osmerus mordax centex, in coastal waters of the Beaufort Sea. Trans. Am. Fish. Soc. 113:33-38.

Craig, P.C., W. Griffiths, L. Haldorson and H. McElderry. 1982. Ecological studies of Arctic cod (Boreogadus saida) in Beaufort Sea coastal waters, Alaska. Can. J. Fish. Aquat. Sci. 39:395-406.

Craig, P.C. and W. Griffiths. 1981. Passage of large fish around a causeway in Prudhoe Bay, Alaska. Arctic 34:314-317.

Craig, P.C. 1978. Movements of stream-resident and anadromous Arctic char (Salvelinus alpinus) in a perennial spring on the Canning River, Alaska. J. Fish. Res. Board Can. 35:48-52.

Craig, P.C., F. Withler and B. Morley. 1977. Effects of methanol on the fertilization of chum salmon (Oncorhynchus keta) ova. Environ. Pollution. 14:85-91.

Craig, P.C. and J. Wells. 1976. Life history notes for a population of slimy sculpin (Cottus cognatus) in an Alaskan arctic stream. J. Fish. Res. Board of Can. 33:1639-1642.

PUBLICATIONS (cont'd)

Craig, P.C. and P. McCart. 1976. Fish use of nearshore coastal waters in the western arctic: emphasis on anadromous species. In: Hood and Burrell (Eds.), Assessment of the arctic marine environment: selected papers. Occas. Publ. No. 4, Inst. of Mar. Sci., Univ. Alaska, Fairbanks. Chapter 26:361-388.

Craig, P.C. 1975. The behavior and distribution of a sand-beach amphipod, Orchestoidea corniculata. Marine Biology. 23:101-109.

Craig, P.C. and P. McCart. 1975. Classification of streams in Beaufort Sea drainages between Prudhoe Bay, Alaska and the Mackenzie River, NWT. Arctic and Alpine Research. 7:183-198.

Craig, P.C. and V. Poulin. 1975. Movements and growth of arctic grayling (Thymallus arcticus) and juvenile Arctic char (Salvelinus alpinus) in a small arctic stream, Alaska. J. Fish. Res. Board of Can. 32:689-697.

Craig, P.C. 1973. Orientation of the sand-beach amphipod, Orchestoidea corniculata. Animal Behavior. 21:699-706.

McCart, P. and P.C. Craig. 1973. Life history of two isolated populations of Arctic char (Salvelinus alpinus) in spring-fed tributaries of the Canning River, Alaska. J. Fish. Res. Board of Can. 30:1215-1220.

Craig, P.C. 1971. An analysis of the concept of lunar orientation in Orchestoidea corniculata (Amphipoda). Animal Behavior. 19:368-374.

McCart, P. and P.C. Craig. 1971. A comparison of meristic characteristics of freshwater and anadromous Arctic char, Salvelinus alpinus. J. Fish. Res. Board of Can. 18:115-118.

Craig, P.C. 1970. The distribution and behavior of the intertidal sand beetle, Thinopinus pictus (Staphylinidae). Ecology. 51:1012-1017.

Craig, P.C. 1968. The activity pattern and food habitats of the limpet, Acmaea pelta. Veliger 11 (Supplement): 13-19.

SELECTED RESEARCH REPORTS

Craig, P.C. 1986. Fish resources in the North Aleutian Shelf, Bering Sea. Rep. by LGL Ecological Research for NOAA/OCSEAP, OMPA, Anchorage, AK. (in prep.).

Truett, J., P. Craig, L. Robbins and S. McNabb. 1985. Proceedings of a synthesis meeting--Norton Basin environment and possible consequences of oil and gas development. Rep. by LGL Ecological Research and John Muir Inst. for NOAA/OCSEAP, OMPA, Anchorage, AK. 237 p.

SELECTED RESEARCH REPORTS (cont'd)

Craig, P.C. 1984. Aquatic survey of the Kaktovik dredging operation, 1983 and 1984. Rep. by LGL for North Slope Borough, Barrow, Alaska. 25 p.

Craig, P.C. 1984. Fish resources. Chapt. 6. In: J. Truett (Ed.), Barrow Arch environment (NE Chukchi Sea) and possible consequences of planned offshore oil and gas development. Proceedings of a synthesis meeting, Girdwood, Alaska, 31 October-2 November 1983. NOAA/OCSEAP, OMPA, Juneau, Alaska.

Truett, J., P. Craig, D. Herter, M. Raynolds and T. Kozo. 1984. Ecological characterization of the Yukon River delta. Rep. by LGL Ecological Research for NOAA/OCSEAP, OMPA, Juneau, Alaska. 138 p.

Craig, P.C. 1983. International study of salmon interceptions in northern British Columbia and southeast Alaska--the 1982 Canadian program. Presented at 9th Annual Meeting of the Alaska Chapter of the American Fisheries Society, Sitka, Alaska, 15-18 November 1982.

Craig, P.C., P. Norton Fraker and J. Peterson. 1983. A comparison of potential marine parks in the southern Beaufort Sea. Rep. by LGL for Parks Canada. 80 p.

Craig, P.C. and D. Schmidt. 1982. Survey of potential dredge sites at Wainwright, Point Lay, Atqasuk, Nuiqsut and Kaktovik. Rep. by LGL Ltd. for the North Slope Borough, Barrow, Alaska. 43 p.

Craig, P.C., K. Bruce and A. Sekerak. 1982. Chapter 1. Fish resources in the upper Liard River drainage, B.C. 184 p.; and Chapter 5, Assessment of impact on stream-dwelling fishes and mitigation, 23 p. In: A.D. Sekerak (Ed.), Fish resources and proposed hydroelectric development in the upper Liard River drainage. Rep. by LGL Ltd. (Sidney) for B.C. Hydro and Power Authority.

Craig, P.C. 1981. Biophysical and social inventory: Fish. p. 19-23; and Biological inventory maps: Fish. p. 42-57. In: Alaska Beaufort Sea coastal sensitivity analysis, Phase 1. Rep. by LGL Ltd. for Absorb Alaskan Beaufort Sea Oilspill Response Body (Houston).

Craig, P.C. and G. Clarke. 1978. Winter and summer fisheries surveys for the Shakwak Highway Improvement Project, British Columbia and the Yukon Territory. Rep. for Public Works Canada. 65 p.

Craig, P.C. 1977. Ecological studies of anadromous and resident populations of Arctic char in the Canning River drainage and adjacent coastal waters, Alaska. Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 41(1):116.

SELECTED RESEARCH REPORTS (cont'd)

Griffiths, W.B., J. DenBeste and P.C. Craig. 1977. Fisheries investigations in a coastal region of the Beaufort Sea (Kaktovik Lagoon, Alaska). Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 40(2):180.

Craig, P.C. and J. Wells. 1975. Fisheries investigations in the Chandalar River region, northeast Alaska. Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 34(1):114.

Craig, P.C. and G. Mann. 1974. Life history and distribution of the Arctic cisco (Coregonus autumnalis) along the Beaufort Sea coastline in Alaska and the Yukon Territory. Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 20(4):32.

Craig, P.C. and P. McCart. 1974. Fall spawning and overwintering areas of fish populations along routes of the proposed pipeline between Prudhoe Bay and the Mackenzie Delta. Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 15(3):36.

Ward, D. and P.C. Craig. 1974. Catalog of lakes, streams, and coastal areas in Alaska along routes of the proposed gas pipeline from Prudhoe Bay, Alaska to the Alaskan/Canadian border. Canadian and Alaskan Arctic Gas, Biol. Rep. Ser. 19:381.

David R. Schmidt
Senior Fisheries Biologist
LGL Akaska Research Associates
PO Box 80607
Fairbanks, Alaska 99708

EDUCATION

1976 Univ. of Kansas, BS - Systematics and Ecology
1980 Univ. of Kansas, MA - Aquatic Ecology; Thesis: The planktivorous feeding ecology of Arctic grayling (*Thymallus arcticus*)

PROFESSIONAL EXPERIENCE

Participated in a study of patterns of anadromous and marine fish movement, and marine invertebrate distribution in the Prudhoe Bay area. This study entailed the capture and tagging of large numbers of anadromous fish as well as the recapture of tagged fish in an effort to document migration patterns. This research was conducted for NOAA/OCSEAP Beaufort Sea Study.

Field Team Leader - ARCO Waterfood Project, Prudhoe Bay, Alaska. This project was conducted to determine the impact of a causeway extension on the distribution and migratory patterns of anadromous fish, and required the tagging of large numbers of fish as well as the subsequent recapture of tagged fish.

Designed and conducted studies in the Sagavanirktok River delta to determine potential effects of the Endicott development on nearshore fish utilization including seasonal distribution and trans-delta migration patterns of tagged anadromous fish. This study was funded by SOHIO Alaska Petroleum Co.

Conducted nearshore fish surveys in the western Beaufort Sea between the Colville River delta and Barrow. This study was funded by NOAA/OCSEAP.

Designed and conducted a winter fish survey in the nearshore Chukchi Sea between Cape Lisburne and Peard Bay. This study was funded by NOAA/OCSEAP.

Field Team Leader - 1984 ARCO Waterflood Project, Prudhoe Bay, AK. This study was a continuation of research concerning the impact of the West Dock causeway extension on the distribution and migratory patterns of anadromous fish.

Participated in the Sept/Oct. 1984 North Aleutian Shelf cruise aboard the NOAA ship R/V MILLER FREEMAN. This study was designed to characterize the nearshore zone, and to determine the relative influence of specific nearshore areas on the North Aleutian Shelf water mass.

Chief Scientist on the Jan/Feb. and the May 1985 North Aleutian Shelf cruises. These were continuations of the previous MILLER FREEMAN cruises.

Acted as Primary Investigator for the 1985/86 Sagavanirktok Delta Fish Overwintering Study. This study entailed location of potential overwintering sites, documentation of fish use at these sites, and relating fish use or abundance to a variety of physical measurements, and to prey abundance. This study was funded by Standard Alaska Production Co.

Participated in the 1986 Bowhead Whale Feeding Study by acting as Field Team Leader of the whale tagging crew. This portion of the study entailed location of large groups of whales, approaching and deploying a VHF radio tag from a two-person kayak, and monitoring whale movement. This study was funded by MMS.

REPORTS

Olson, T., D.R. Schmidt, R. Neterer and D. Troy. 1980. Fall fisheries survey and provisional list of waterbodies along the Alaska gas pipeline route (Prudhoe Bay to the Yukon Territory) proposed by Northwest Alaska Pipeline Co. by LGL Alaska Research Associates, Inc. 339p.

Schmidt, D.R., R. Neterer, C. Welling, D. Troy and T. Olson. 1981. Fisheries resources along the Alaskan gas pipeline route (Prudhoe Bay to the Yukon Territory) proposed by Northwest Alaska Pipeline Co. by LGL Alaska Research Associates, Inc. 595p.

Barnard, D., D.R. Schmidt, D. Troy and C. Welling. 1981. Spring 1981 fisheries survey and provisional list of waterbodies along the Northwest Alaskan Pipeline Co. route: Prudhoe Bay to the Yukon Territory. Prepared for the Northwest Alaskan Pipeline Co. by LGL Alaska Research Associates, Inc. 242p.

Craig, P. and D.R. Schmidt. 1982. Survey of potential dredge sites at Wainwright, Point Lay, Atqasuk, Nuiqsut and Kaktovik. Prepared for the North Slope Borough, Material Source Division, Barrow, Alaska by LGL Alaska Research Associates, Inc. 43p.

Griffiths, W.B., D.R. Schmidt, R.G. Fechhelm and B.J. Ballaway. 1982. Volume III: Fish ecology. In Environmental summer studies (1982) for the Endicott Development, B.J. Gallaway and R.P. Britch, (eds.). Prepared for SOHIO Alaska Petroleum Co., Anchorage, AK.

Schmidt, D.R., R.D. McMillan and B.J. Gallaway. 1983. Nearshore fish survey in the western Beaufort Sea: Harrison Bay to Elson Lagoon. Prepared for the Juneau Project Office, NOAA-OCSEAP.

Craig, P. and D.R. Schmidt. 1985. Fish resources at Point Lay, Alaska. Prepared for the North Slope Borough, Material Source Division, Barrow, AK.

Schmidt, D.R., W.B. Griffiths and L.R. Martin. 1986. Sagavanirktok delta fish overwintering study. In Genetic and overwintering studies of the Arctic cisco (*Coregonus autumnalis*), 1985-86. B.J. Gallaway (ed.). Prepared for Standard Alaska Production Co. 140p.

PUBLICATIONS

O'Brien, W.J. and D.R. Schmidt. 1979. Arctic *Bosmina* morphology and copepod predation. Limnology and Oceanography. 24:564-568.

O'Brien, W.J., D. Kettle, H. Riessen, D.R. Schmidt and D. Wright. 1980. Dimorphic *Daphnia longiremis*: Predation and competitive interaction between the two morphs. In Evolution and ecology of zooplankton communities, W.C. Kerfoot (ed.). Univ. Press of New England, Hanover, NH.

Schmidt, D.R. 1982. A brown bear (*Ursus arctos*)- human encounter in the Brooks Range, Alaska. Can. Field-Nat. 96:347.

Schmidt, D.R. and W.J. O'Brien. 1982. The planktovouous feeding ecology of Arctic Grayling (Thymallus arcticus). Can. J. Fish. and Aq. Sci. 39:475-482.

Schmidt, D.R. and S.R. Johnson. (in prep). Significant range extension of the Pacific spiny lumpsucker (*Eumicrotremus orbis*).

Green, J.E., S.R. Johnson and D.R. Schmidt. (submitted). The effects of winter industrial activities on the distribution and abundance of ringed seals in the Alaskan Beaufort Sea.

Schmidt, D.R., W.B. Griffiths and L.R. Martin. The importance of anadromous fish overwintering habitat in the Sagavanirktok River delta, Alaska. 1987. Biological Papers of the Univ. of Alaska. (submitted).

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES

PROJECT OPERATIONAL PLAN

RESPONDENTS TO THE REQUEST FOR PROPOSALS MUST COMPLETE THIS FORM

Title: South Peninsula Salmon Tagging 1987

Project Leader: Peter Craig

Date Submitted: December 30, 1986

Region: CFS

Fishery Unit: VARIOUS

Yellow Book Project No.: 190

Fiscal Year: 1987 Total Project Cost: $115,000

FOR FISH AND GAME USE ONLY

APPROVAL

Level	Signature	Date
Biometric:		
Regional:		
Divisional:		

I. TITLE: South Peninsula Salmon Tagging 1987

II. OBJECTIVES:

A. List the specific objectives beginning with the highest priority:

1. Apply at least 15 000 readily visible external tags to chum salmon within the study area and return healthy tagged fish to the water

2. Apply at least 10 000 readily visible external tags to sockeye salmon in the study area and return healthy tagged fish to the water

3. Publicize the tagging effort to harvesters and agencies in Asia and North America

4. Tabulate and document data on the tagging of each fish and the recovery of each tag

5. Communicate the results of the tagging study in a coherent and timely manner.

B. To what Fisheries Management Operational Plans will this project contribute?

Species	Gear	Location
chum	purse seine/gillnet	Shumagins/South Unimak
chum	purse seine/gillnet	various North Peninsula
chum	gill net	Nushagak
chum	gill net	Kuskokwim
chum	gill net	Kotzebue
chum	gill net	Norton Sound
summer chum	gill net	Lower Yukon
fall chum	gill net	Upper and Lower Yukon
sockeye	gill net	various Bristol Bay
sockeye	gill net	Kuskokwim
sockeye	purse seine/gillnet	Shumagins/South Unimak
sockeye	purse seine/gillnet	various North Peninsula

III. NEED OR PROBLEM ADDRESSED:

A. Describe the public and/or resource need addressed by the project and the project's benefits.

Migrating sockeye and chum salmon have been harvested in the South Unimak and Shumagin Islands June fisheries since 1911. The chum salmon harvest is incidental to the more intensely managed sockeye salmon harvest. Several tagging studies conducted during

the period 1956-1963 showed that a substantial fraction of the sockeye and chum salmon available to these fisheries were not of local origin. For chum salmon the pattern of tag recoveries indicated that these fisheries were intercepting fish primarily of western Alaska origin although tags were recovered from widely dispersed areas throughout the Alaska Peninsula, Japan, the U.S.S.R., British Columbia, and Puget Sound. For sockeye the pattern of tag recoveries indicated that these fisheries were intercepting primarily Bristol Bay fish with minor interceptions of sockeye bound for North Alaska Peninsula river systems.

A considerable amount of controversy has developed in recent years over the level of chum salmon catches in these fisheries. Since 1980, chum salmon harvests in the South Unimak and Shumagin Islands fisheries have averaged 624 thousand fish, including a record harvest of chum during 1982 (1.1 million fish) and 1983 (784 thousand fish). These large catches, well above the average harvests of 1970-1979 (306 thousand fish) and 1960-1969 (186 thousand fish), are a result of the large sockeye salmon catch quotas established in response to increased sockeye salmon returns to Bristol Bay. Sockeye salmon catch quotas are based on a fixed percentage of the forecasted harvest in the Bristol Bay inshore districts. While the current management strategy appears adequate to maintain a consistent level of exploitation on Bristol Bay sockeye salmon, this fishing strategy is independent of chum salmon abundance. Exploitation rates for chum salmon may have reached a level where the inshore returns of some stocks could be adversely impacted. In recent years, the inshore returns of several western Alaskan chum salmon runs, most notably Yukon River fall chum and Kuskokwim River summer chum, were less than expected and interceptions in the South Unimak and Shumagin Island fisheries may have contributed to these poor returns. Most western Alaskan chum salmon stocks are fully utilized in terminal commercial and subsistence fisheries, therefore it would be impossible to sustain chum salmon production in the face of increased exploitation in marine interception fisheries. Since marine fisheries occur before terminal harvests each year, the long term result of increased marine exploitation is an inevitable reduction in harvest levels in the respective terminal fisheries. However, it is impossible to quantify the impact of the South Unimak fishery on western Alaskan chum production without adequate knowledge of the stock composition of the catch.

Unfortunately several problems associated with previous studies have limited their relevancy to resolving current allocation and conservation disputes. The most important problem with previous studies from the point of view of this study is that tagging occurred in a broad area that included, but was not limited to, the present area of the fishery. Stock composition may differ across time and space and the historical tagging effort was insufficient to detect these differences. For instance, the Shumagin Island catches may be composed of different stocks than the South Unimak catches. The information provided at the end of this study is expected to answer the questions of the presence or absence of various Asian and North American chum salmon stocks in the contemporary state commercial harvest areas adjacent to

the south side of the Alaskan Peninsula.

When this tagging study provides a current, qualitative analysis of which major chum salmon stocks are potentially present in the South Peninsula June fishery, it will have defined the chum stocks to include in scale pattern analysis models, SPA, and it will be possible to develop the appropriate mix of standards on which SPA discriminant models are estimated. The tagging study will also provide evidence for differential migratory timing among stocks in the South Peninsula fishery. There is concern that certain stocks may be more vulnerable to the South Peninsula Fishery because these stocks show migratory timing more coincident with the South Peninsula fishery. These include sockeye stocks from Bristol Bay which have spent two winters in the ocean such as Kvichak River and the Wood River beach spawners, Ugashik sockeye, and Yukon fall chums. With the exception of Ugashik sockeye, there are some conservation concerns associated with the management of terminal fisheries on these stocks.

B. How will the success of the project be judged?_____

1. By the number of tags applied_____
2. By the geographic extent and depth of market penetration for publicity
3. By the efficacy of the passive recovery effort
4. By the content and professionalism of the contract report

IV. PROJECT DESCRIPTION:
This study is to procure the services of capture, external tagging, release, and processing of recovery data for chum and sockeye salmon during the time period June 3 - July 8 , 1987. This area and time and its fishery are collectively known as the South Peninsula June fishery. The study is to provide for costs of tagging and releasing no less than 25,000 salmon. Preference will be given to the proposal which shows how to maximize the number of readily visible tags deployed subject to the constraint of a maximum cost, including overhead, of $115,000 from June 3 - June 30. The salmon are to be tagged and released in good physical condition in both the South Unimak District and the Shumagin Island section of the Southeastern District with tagging effort being as evenly distributed across areas through time as possible in a manner which insures that a constant fraction of the population in the area of the fishery is tagged. Both sockeye and chum salmon are to be tagged. The tagging program is to be designed so that fraction of the population tagged is the same with respect to time and species and to the extent possible with respect to the two fishing districts. The study is to provide for the cost of the charter of purse seine vessels and crew for capture of salmon, as well as technical personnel for tagging, recording and tabulation of tagging and recovery data in electronic format.

IV. A. Location: in the marine waters of the State of Alaska bordering the south side of the Alaskan Peninsula between 54

degrees N latitude and 56 degrees N latitude. The actual distribution of tagging effort in time and space is to conform to the historical average time and space distribution of commercial fishing effort

B. Field Program Duration: Approximately June 3 - July 8, 1987; distribution of tagging effort is to be uniform with respect to time and space, to insure that a constant fraction of the population is tagged within each fishing district. The relative tagging effort in the two fishing districts should reflect the relative historical fishing effort in the two districts. NB: Funding for July I - July 8 is contingent on appropriation by legislature. Budget should end on June 30 and resume on July 1.

C. Sampling Duration If Different Than Above: NA

D. Frequency Of Sampling While In The Field: 41 boat-days of tagging, with the distribution of effort as described in the Technical Proposal.

E. Longevity Of The Project: [ ] 1 year, [ ] 2 years, [X] 3 years, [ ] continuing

F. Is this project new? [X] Yes, [ ] No

V. DATA COLLECTION:

A. Types of Data Collected:

1. Species,length,age, date of tagging, locality of tagging, tag number
2. Species,date of recovery, locality of recovery, method of recovery, tag number
3. For internal consistency checks: tagging vessel, tagger, set time, set
4. number, and number of fish tagged per day per vessel.
5.
6.

B. Sample Collection Methods: Gear: Seining will be the mode of capture, and standard procedures used to insure that fish are tagged and released in good condition. Spaghetti tags are to be used, with each tag having a unique number

(Append sampling manual or field guide if pertinent)

C. Means of Recording Each Data Type: LGL personnel on each seiner will record data on standardized waterproof tagging forms and maintain a personal log of sets and tags released. Quality control measures are described in the Technical Proposal. Scale samples will be stored on pre-labeled gummed cards.

(Attach paper or electronic data format if available)

VI. DATA ANALYSIS:

A. What determines how many samples (observations) of each data type will be taken? The criteria for tag application are two-fold: (1) the relative tagging effort should reflect historical fishing efforts in the two fishing areas, and (2) a constant fraction of the populations are to be tagged through time.

B. What types of statistics are computed? The primary purpose of this project is to determine the origin of stocks intercepted by the fisheries, and as such, the recovery of tags is the primary goal. The nature of the project also lends itself to straightforward descriptive statistics: (1) weekly numbers of tag release of chum and sockeye from the two fishing areas, (2) the geographical distribution of tag recoveries by week of release, and (3) the mean number of days at large between release and recovery for fish caught in geographic regions.

C. What types of statistical tests are applied? Simple descriptive statistics (see B. above).

D. What questions will each test help you evaluate? As stated above, the principal question is what are the origins of salmon intercepted by the fisheries. A second important question concerns the run timing of various stocks as they pass through the fisheries. What are these timings and how do they compare to those previously described by Brannian (1984)?

E. Where, how, when, and with what hardware and software will these analyses be conducted?

An electronic data base containing the tagging information will be provided on completion of the project. The data base should constructed using RBASE 5000, and set up so that records can be sorted and retrieved by each of the 6 variables identified in specification V.A.1 above. The data base should be stored on a

medium that can be loaded onto IBM personal computer or compatible with 10 Mbyte hard disk.

As detailed in the Technical Proposal, tag release forms and tag recovery data are first entered onto 5.25 inch soft diskettes using specially designed software (from LGL's North Coast Salmon Tagging Study). This will be done using and Apple II at the LGL office in Juneau. Format conversion routines will then be used to convert the data from the random access format used by the input/editing routes to a sequential format suitable for transfer to the VAX minicomputer (using a Modem Magic Package) in the LGL Sidney office. Analytical programs will be run on the VAX database. A file tranfer routine will convert the data into a form suitable for acceptance by RBASE 5000, run on an IBM PC.

VII. REPORTING:

A. What types of documents will be written by whom on what schedule?
A report documenting methods used in the tagging, narrative of activities, and daily logs documenting numbers by species, and areas of releases. The report should contain an appendix of the raw tagging data.

Report	Author	Completion Date
1987 South Peninsula Tagging Study	Peter Craig	September 30, 1987

VIII. PROJECT BUDGET: Budget period is July 1 - June 30. Prepare separate budget for each budget period.

A. By Line Item:

Line	Part 1	Part 2
Personnel	28030	24005
Travel	5015	1840
Contractual	61930	13755
Supplies	9525	5700
Fee	10450	4530
Total	114,950	49,830

B. What is the cost per sample for each data type?

	Data Type	Cost/Observation
1.	Total Cost ($164,780)/25,000 tags	$6.59/tag (includes tag application, scale sample, tag recovery, and report)
2.		
3.		
4.		
5.		
6.		

C. Project Positions:

Name	months
Peter Craig	2.3
David Schmidt	1.3
Data Manager	0.3
Data Technician	0.7
Tagger -1	0.9
Tagger -2	0.3

VIII. D. How many man months are assigned to each position for data analysis.

Name	Report	mm
Peter Craig	1987 South Peninsula Tagging Study	0.5
Dave Schmidt	1987 South Peninsula Tagging Study	0.3
Data Technician	1987 South Peninsula Tagging Study	0.7
Data Manager	1987 South Peninsula Tagging Study	0.2

E. How many man months are assigned to each position for report writing and other presentations of project data?

Name	Report	mm
Peter Craig	1987 South Peninsula Tagging Study	0.6

IX. ADD ANY ADDITIONAL RELEVANT INFORMATION HERE

LGL Ecol. Res.
2950 Fritz Cove Rd.
Juneau, AK 99801
27 January 1987

Phil Rigby
Alaska Dept. Fish and Game
Division of Commercial Fisheries
P.O. Box 3-2000
Juneau, AK 99802

Dear Phil:

Re: 1987 South Peninsula Tagging Project

Based on our review meeting last week regarding LGL's proposal for the salmon tagging project, we are in agreement with the following modifications to our proposal:

1. TAGS. We will order 30,000 spaghetti tags (rather than 25,000) as soon as possible after our contract is finalized. A price quote will first be submitted to ADFG. The tag message will read:

00001 $500 LOTTERY X Y: BOX 3-2000, JUNEAU ~~AK~~ Alaska 99802 USA

where X and Y stand for " send to" in Japanese.

2. SCALES. In order to maximize the time available to tag fish, all scale sampling will be deleted.

3. VESSEL CHARTERS. If vessel charter costs can be reduced, LGL will perform the tagging as specified in the RFP for less than the amount proposed or provide more tagging effort for the amount proposed.

4. PROJECT REPORT. In the event that Phase 2 of this project is not funded, Phase 1 will have to include tagging activities as well as a report and database covering these activities. We have therefore prepared a budget option for this (Table 1).

Using the vessel charter costs submitted in our proposal, we estimate that 27 boat-days are available for tagging if only Phase 1 is funded. These boat-days would be distributed according to ADFG's guidelines of allowable harvest, with most tagging occurring during 10-25 June (Table 2).

Should you have any questions, please give me a call.

Sincerely,

Peter Craig

Peter Craig
Project Manager

cc. John Cole

Table 1. PHASE 1 OPTION: budget.

Personnel (includes overhead)

	RATE	DAYS	TOTALS
Craig	390	64	24960
Schmidt	315	39	12285
Tagger-1	150	18	2700
Data Manager	400	2	800
Data Technician	200	10	2000

Disbursements

3 rtn flts: misc.AK-Sand Point	2900
3 rtn flts: sand pt.-King Cove	550
Field accommmation at $575/mo	575
Food: 27 days at $30/day	810
Floy spaghetti tags (30,000)	7650
Misc. gear (dipnets, etc.)	780
Communications	690
Report prep./production	300
Publicity (flyers, postage, etc.)	2000
Tag lottery (one $500 prize)	500

Boat Charters

Boat 1: 6 days at $1300/day	7800
Boat 2: 13 days at $1750/day	22750
Boat 3: 8 days at $1800/day	14400
	104450
10% fee	10445
TOTAL	$114,895

Table 2. PHASE 1 OPTION: estimated number of boat-days for salmon tagging.

Period	SOUTH UNIMAK		SHUMAGINS	
	Allowable* Harvest (%)	Boat-Days	Allowable* Harvest (%)	Boat-Days
June 1-11	5	1	9	1
12-18	29	7	28	2
19-25	51	10	41	2
26-30	15	3	22	1
	100	21	100	6

* 1986 ADFG guidelines